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Applicant	: NAKAO
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Examiner	: L. Martir
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Hon. Commissioner of Patents
and Trademarks
Washington, D.C. 20231

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APPEAL BRIEF

I. REAL PARTY IN INTEREST

This application is assigned to OVAL CORPORATION.

II. RELATED APPEALS AND INTERFERENCES

Appellant, Appellant's legal representative, or assignee has no knowledge of any appeals or interferences which will directly effect or be directly effected by or have a bearing on the Board's decision in the pending appeal.

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III. STATUS OF CLAIMS

Claims 1 - 12 stand rejected and are on appeal.

IV. STATUS OF AMENDMENT AFTER FINAL REJECTION

An Amendment After Final Rejection was filed June 26, 2003. The Advisory Action of July 29, 2003 indicates that this proposed Amendment will not be entered because it is not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal. Applicant notes that this Amendment After Final only reduces redundancies in claim 12. It is Applicant's understanding that this change to claim 12 should not effect the rejections, but should only make the claim easier to read.

V. SUMMARY OF THE INVENTION

The present invention is a Coriolis mass flow meter. Flow meters based on the Coriolis effect are known. These flow meters have two tubes which extend or lie substantially parallel to each other. There is an inlet manifold feeding the two tubes and an outlet manifold joining the flow exiting the two tubes. The flow is theoretically divided evenly between the two tubes and then joined together after the fluid flows through the tubes.

Theoretically a Coriolis mass flow meter does not require two tubes, but instead can operate with only one tube. In an example, assume that the manifolds are fixed and the middle of the tube moves from the left to the right. The fluid entering the tube has a zero velocity from left to right and therefore must be accelerated from left to right as it travels towards the middle of the tube. At the middle of the tube, the fluid now has the velocity of the middle of the tube. As the fluid travels from the middle of the tube to the end of the tube, the end of the tube is at a zero left-to-right velocity, and therefore the fluid must slow down its left-to-right velocity as

it travels from the middle to the end of the tube.

The acceleration from left-to-right as the fluid moves towards the middle, applies a force to the left side of the tube and causes the tube to bend slightly towards the left. Conversely, as the fluid moves from the middle of the tube to the end of the tube, the left-to-right velocity must be slowed down, and this applies a force to the right side of the tube. The second half of the tube therefore bends or deflects slightly to the right.

The amount force required to increase the left-to-right velocity, and then to decrease the left-to-right velocity depends on the amount of flow in the tube. The higher the flow, the greater the force to increase and decrease the left-to-right velocity. By measuring how much the tube deflects from the beginning to the middle, and then from the middle to the end, one can determine the magnitude of the flow inside the tube.

In real life, it is impractical to have a middle of the tube constantly move from left-to-right. Therefore the tube is often vibrated from left-to-right, and then from right-to-left. Deflections are then measured during the left-to-right movement, and then during the right-to-left movement. The middle of the tube therefore performs a vibrating motion during the measuring of the fluid flow rate.

In order to make vibrating of the tube, and the measuring of the deflections easier, two parallel tubes 1, 2 are used and a vibrating drive unit 15 is connected to the two tubes 1,2 at the middle of the two tubes. This vibrating drive unit 15 spreads the middle of the tubes apart and then brings them back together to form the left-to-right and right-to-left movement of the middle of the tube. Sensors, 16 and 17 in the present drawings, are then placed between the

beginning of the tube and the middle of the tube, and between the middle of the tube and the end of the tube, page 1 lines 22 - 24.

Because one tube moves from left-to-right while the other tube moves from right-to-left, the deflection of the tubes will be in the opposite direction. The tubes therefore alternate between being deflected where they are forced together, to where they are spaced apart. By placing a sensor at these positions, it is easy to determine and measure the deflection of the tubes. Also, since there are two tubes involved, the deflection amount is greater and therefore easier to measure accurately.

Errors can occur due to external vibrations, and differences in the vibrational characteristics of the tubes. U-shaped tubes or tubes such as shown in Fig. 5 of the present application are known and address many of these problems. However such U-shaped tubes must be very long and take-up a large amount of space in a direction perpendicular to the original flow direction, page 2 lines 10 - 14. It is also possible to have a straight tube Coriolis mass flow meter. Such a flow meter can be placed in the axial direction of flow and takes up much less space then a U-shaped tube meter. However, such straight tube-type meters have a problem due to temperature fluctuations, page 2 line 23 - page 7 line 7.

Applicant has found that if a basically straight tube Coriolis mass flow meter is used, many of the disadvantages of the straight tube can be overcome by having the tubes being slightly arched. Applicant has also found that this slight arch requires three bends for each tube as shown in present Fig. 6, the tube from left-to-right must be first bent in the upward direction at the left most radius r. This is a very sharp bend and does not last very long. The tube must

be then bent away from the upward direction in a very slow and large bend radius R. Finally there must be another sharp short bend r shown on the right side of Fig. 6. Applicant has found that this forming of three bends is somewhat difficult, especially when two tubes must be bent exactly the same way. Because of minor variations in the bends, which especially occurs when two or more bends are formed, the vibrational characteristics of the tubes varies greatly. Applicant has also found when the vibration or characteristics vary between the two tubes of a Coriolis mass flow meter, the accuracy decreases, page 3 lines 12 - 19.

In order to overcome the problem of a flow tube having three separate bends, the present invention forms the Coriolis mass flow meter from two basic parts. One of the basic parts is the flow tubes themselves. The flow tubes are formed with a single bend in a single direction, page 4 lines 11 - 12 and page 7 lines 16 - 17. The second basic part is the manifold. As an example, the inlet manifold has an inlet portion and divides fluid from the inlet portion into a first inlet branch and a second inlet branch. The inlet portion has an axial direction which is usually in line with the flow being received by the meter. The inlet branches extend and curve from the inlet manifold at an angle to the axial direction. The inlet manifold and the flow tubes are curved, so that the direction of the end of the branches of the manifold is the same as the direction of the end of the flow tubes. The inlet manifold therefore forms the first bend for the fluid going into an arch shaped Coriolis meter. The flow tubes then form the second bend for the meter. The outlet manifold is formed similar to the inlet manifold so that the end of the branches of the outlet manifold are in the same direction as the ends of the flow tube. The axial direction of the outward portion of the outlet manifold is also in the axial direction of the inlet

portion of the inlet manifold, page 4 lines 13 - 16 and page 7 lines 5 - 13.

The present invention can thus make an arched flow tube meter where each part only has a single bend. Single bends are much easier to manufacture and can be more uniformly manufactured. The transition from one curve or bend to another, is then formed by the joint between the manifolds and the flow tubes. By placing the joint at this point, the present invention has been able to eliminate the need for manufacturing a part which has two or more bends in it. By eliminating this two or more bend manufacturing step, the vibrational characteristics of the parts of the present invention are more uniform. This results in the accuracy in the present invention increasing, and the variation between different meters, or even from one flow tube to another, decreasing, page 4 lines 16 - 19 and page 7 lines 16 - 19.

In order to further reduce external vibrations, and to keep the vibrations caused by the driver 15 inside the flow tubes, a case 31 surrounds the flow tubes and is connected to the manifolds. Applicant has found it particularly beneficial for the manifolds to be arranged in a corner of the case. This prevents any leakage of the vibrations caused by the drive unit 15, and also helps keep external vibrations from effecting the flow tubes, page 4 lines 20 - page 5 line 2 and page 8 lines 12 - 17. The case is preferably formed with a cylindrical, especially oval shape, as shown in Figs. 1 and 2 for the cylindrical or circular shape, and in Fig. 7b for the oval shape.

By forming the flow meter from two basic parts which each only have one curve, the present invention is easy to manufacture and accurate in operation. Furthermore by providing a case around the flow tubes, where the manifolds are connected in a corner of the case, further

increases accuracy of the meter.

VI. CONCISE STATEMENT OF ALL ISSUES PRESENTED FOR REVIEW

(1) Whether claims 1 - 11 are unpatentable under 35 USC § 103 over Cage in view of Lew and further in view of Keita.

(2) Whether claim 12 is unpatentable under 35 USC § 103 over Keita in view of Lew.

VII. GROUPING OF CLAIMS

Appellant asserts that each of claims 1 - 5, 10 and 11 rejected under 35 USC § 103 are patentable. Claims 6 - 7 stand and fall together.

Appellant asserts that claim 12 rejected under 35 USC §103 over Keita in view of Lew is separately patentable.

VIII. ARGUMENT

Issue 1

Claim 1 sets forth two parallel flow tubes curved into an arch shape having joint ends where each of the joint ends has an end direction. In the embodiment of present Fig. 1, the flow tubes are represented by reference numbers 1 and 2. Claim 1 also sets forth an entry side manifold and an exit side manifold. One of these manifolds is represented by reference 25 in the embodiment of Fig. 1. The other manifold is hidden in the view of Fig. 1. The manifolds are set forth as having curved branches being smoothly bent from an inlet direction to a

connection direction. The connection direction is set forth in claim 1 as being the same as the end direction of the joint ends of the flow tubes.

In the embodiment of Fig. 1, the joint tube 1 has a curve that is opened in the downward direction. The curved branches of manifold 25 in Fig. 1 are curved in a somewhat upper direction. The left side of the branch of manifold 25 is in the same direction as the right side end of flow tube 1. Claim 1 therefore sets forth the structures of the flow tubes, and the manifolds each having one curve. These curves are shaped, so that the flow meter can be assembled without any additional curves being required.

Applicant has found that forming two curves in a single structure is difficult, especially with regard to reproducing those same two curves over and over again. Applicant has found that it is much easier to have uniformity between flow tubes, when each flow tube is formed with a single bend. Applicant has found that this is possible when exhaust manifolds are formed with a curved branch and the end of the curved branch is in the same direction as the end of the flow tube. This avoids the problem of forming curved flow tubes with two or more curves, and the corresponding reproducibility inaccuracies.

Applicant has reviewed the prior art, and finds no teaching nor suggestion of a flow tube having only one curve, manifolds having only one curve, and where a connection between the manifolds and the flow tubes are in the same direction. The rejection states that Lew has flow tubes 44 and 45 joined to manifolds 47 and 47. Applicant assumes the Examiner is referring to elements 46 and 47 of Lew. Applicant has reviewed these elements of Lew, and in particular Fig. 5 of Lew. Applicant finds no teaching nor suggestion in Lew of separate structures of a

manifold and a flow tube. Instead it appears that Fig. 5 of Lew shows a one piece construction and does not provide any details with regard to how any manifolds or flow tubes are formed. Lew clearly does not indicate separate manifolds and flow tubes. Lew therefore cannot indicate how and where a manifold would be connected to a flow tube. Therefore Lew cannot disclose the specific <u>relationship</u> between the manifolds and the flow tubes in claim 1. Since this specific relationship is not present in Lew, Lew cannot anticipate this feature of claim 1, or cause this feature to be considered obvious.

The rejection also indicates that Keita discloses a similar arrangement of elements that comprise two measuring tubes 13 and 14 as shown in Figs. 2b and 3 that have a similar shape as the tubes 1 and 2 in Applicant's Figs. 1, 5 and 7. Applicant notes that Applicant's Figure 5 is a U-shaped tube and is indicated to be prior art. Applicant has reviewed Figs. 2b and 3 of Keita, and does not find any teaching nor suggestion of a manifold with curved branches, especially where ends of the curved branches are in a direction that is similar to the direction of the ends of the flow tubes. Instead it appears from Figs. 2a and 3 of Keita that elements 13 and 14 have three individual bends, and that any manifold does not have any bends or curved branches at all. Therefore Keita cannot anticipate all of the features of claim 1, especially the relationship between the flow tubes and the manifolds.

Applicant has further reviewed Keita, and notes that Figs. 5 and 7 of Keita clearly show flow tubes 34 and 44 having a bend in the center, and two bends at each of the right and left ends. Elements 31 and 32 appear to be the structure most similar to the manifolds of the present invention, however elements 31 and 32 do not have any curved branches. Therefore

it is quite clear that Keita does not have the relationship between the manifolds and the branches set forth in claim 1.

Applicant further notes that Fig. 5 in Lew, and the tubes in Keita, have more than one bend which Applicant has found to be disadvantageous. As Applicant has described previously, and in the original specification, it is difficult to uniformly and repetitively produce flow tubes having more than one bend or curve. None of the prior art seems to recognize the difficult reproducibility of flow tubes in the corresponding references or the inaccuracies that it creates. It is only the present Applicant who sets forth this difficulty, and provides a solution. The flow meters of the present invention are therefore easier to produce, and/or less costly to manufacture. The specific flow tube and manifold combination of present claim 1, therefore is an improvement over the prior art, by providing more accurate or less expensive flow meters. Applicant respectfully requests patent protection for this improvement.

Applicant also notes that the embodiment of Fig. 5 of Lew does not use a pair of oscillation sensors installed along two parallel flow tubes, as set forth in claim 1, but instead uses differential pressure sensors 50 and 51. Figure 5 of Lew therefore is a different type of meter and does not have the same difficulties with vibration. Applicant has found that the difficulty of forming more than one curve in a flow tube causes difficulty in having the same vibration characteristics from flow tube to flow tube. The oscillation sensors of the present invention measure the vibration of the flow tubes. Since the embodiment of Fig. 5 of Lew does not measure vibration or oscillation at two separate points, but instead measures differential pressure, a person of ordinary skill in the art would not be led to believe that the particular

shape of Fig. 5 of Lew would also be beneficial when a pair of oscillation sensors are used to measure vibration. Therefore it is Applicant's position there would be no incentive or motivation for the person of ordinary skill in the art to take the shape of Fig. 5 of Lew and incorporate that into Cage.

The rejection states that it would have been obvious to modify Cage using the teachings of Lew or Keita since Cage himself suggests that a plurality of shapes and flow conduits could be utilized as long as they oscillate in a resonant manner. Applicant notes that Lew describes in column 8 lines 44 - 53, that the invention of Lew can be flexually vibrated at any desired frequencies, which may or may not be a natural frequency. Therefore a person of ordinary skill in the art looking for shapes of conduits that oscillate in a resonant manner, would not be led to the conduits of Lew. Lew is not concerned with natural frequencies, and operates on frequencies other than natural frequency. A person of ordinary skill in the art would have no indication in Lew, that the shapes of flow conduits would oscillate in a resonant manner. Therefore the suggestion or motivation in the rejection is contradicted by Lew, since Lew does not indicate that a resonant or natural frequency is needed. Claim 1 therefore further defines over the combination of the references.

Claim 5 also sets forth flow tubes and manifolds. The manifolds are set forth as having exit passages with a smooth curve where an axial direction of the passages at the ports or ends is in substantially the same direction as an axial direction of a respective end of a respective flow tube. This feature is similar to the relationship between the curved branches and the flow tubes in claim 1. As Applicant has described previously, this relationship between flow tubes and

manifolds is not taught nor suggested in the prior art. Claim 5 therefore defines over the prior art for the same reasons as claim 1.

Claim 5 also sets forth that the two flow tubes have a curve and that each curve forms an arch extending <u>fully</u> from a respective first joint end to a respective second joint end. Applicant notes that the main prior art of Cage does not show two flow tubes each having a curve where each curve forms an arch extending fully from a respective first joint end to respective second joint end. Instead it appears that Cage describes U-shaped tubes which clearly have two bends and three straight portions. Applicant notes that in the rejection of claim 5, Cage is used to disclose the flow tubes by elements 11 and 11'. Since elements 11 and 11' in Cage do not form an arch extending fully from a respective first end to a respective second end, the rejection does not show how all of the features of claim 5 are present in the prior art. The statements supporting the rejection are therefore untenable.

Claim 5 further sets forth that the direction of the outlet ports of the entry side manifold are at an acute angle relative to the axial direction of the inlet port. Likewise claim 5 also sets forth that the direction of the exit passages the exit side manifold is at an acute angle relative to the axial direction of the outlet port portion. This further emphasizes the difference in the shape between the flow tubes of claim 5 and the prior art, since the ends of the flow tube of claim 5 are in the same direction as the passages of the manifold. The rejection appears to use the reference of Lew to show the acute angle, and states that it would have been obvious to use the shape of Lew, since Cage suggests that a plurality of shapes of flow conduits could be utilized as long as they oscillate in a resonant manner. However Lew describes in column 8

lines 44 - 53 that the invention of Lew can be flexually vibrated at any desired frequency which may or may not be a natural frequency. Therefore a person of ordinary skill in the art looking for shapes of conduits that oscillate in a resonant manner, would not be led to conduits of Lew. There is no indication that the conduits of Lew would resonate at a desirable natural frequency. Instead Lew is designed to operate of frequencies other than natural frequency. The suggestion or motivation then in Cage that a plurality shapes or flow conduits could be utilized as long as they oscillate in a resonant manner, therefore does not apply to Lew. Claim 5 therefore further defines over Lew.

Applicant also finds no suggestion or motivation in the prior art which would lead a person of ordinary skill to replace the U-shaped tubes of Cage with tubes having a curve that form an arch extending fully from one end to another. Applicant notes that the U-shaped tubes in Cage, and the placement of the sensors in Cage clearly indicate that the deflection of the flow tubes is based on the fluid flow in a direction that is perpendicular to the original flow. Therefore sufficient length must be provided in this perpendicular direction so that the deflection is of a large enough magnitude to be accurately measured. As described previously, the measuring in the perpendicular or lateral direction has several advantages that increase accuracy. However, this design also has the disadvantage of requiring an excess amount of space. Replacing the U-shaped tube of Cage with a tube having a curve forming an arch extending fully from one end to another, would change the principal of operation of Cage. Applicant notes that such a modification is not an indication of obviousness according to U.S. patent regulations. Claim 5 therefore further defines over the prior art.

Claim 2 sets forth that the Coriolis meter further comprises a sealed pressure resistant case of a cylindrical case with openings of the cylindrical portion being closed by end plates. In the embodiment of present Fig. 1, the case is represented by reference 31, and the end plates by reference 32. Applicant's review of Cage, finds no teaching nor suggestion of a cylindrical case, with openings in the cylindrical portion being closed by end plates. It appears that the rejection relies on element 14 of Cage for this structure. However Applicant finds no teaching nor suggestion of element 14 having openings which are closed by end plates.

Claim 2 also sets forth that the entry side and exit side manifolds are installed at corners of the case and are passed through the corners. It appears from Cage, that element 14 is spherical in shape, especially from Fig. 1 of Cage. Applicant finds no teaching nor suggestion of element 14 having corners, or of manifolds being arranged at corners of a case. From Figs. 2 and 5 of Cage, it appears that element 14 is not perfectly spherical, but still does not have any corners. It also appears that elements 12 and 12' of Cage which have been equated with the manifolds of the present invention, are not even mounted in any of the smaller radius portions of element 14 of Cage. Cage therefore appears to clearly fails to show any manifolds being mounted even remotely close to any corners of element 14. Claim 2 therefore further defines over the prior art.

Claim 3 also sets forth a pressure resistant case. Claim 3 then sets forth that the entry side and exit side manifolds have a pair of integrally formed disk-shaped flanges to which ends of the pressure resistant case are fixed. The rejection relies on element 14 of Cage to teach a pressure resistant case. The rejection also states that elements 12 and 12' of Cage have a pair

of integrally formed disk-shaped flanges to which both ends of the case are fixedly fitted. Applicant has reviewed elements 12 and 12' of Cage, and finds no teaching nor suggestion of disk-shaped flanges which are fitted to ends of element 14. The rejection states that this feature is shown in Fig. 1 of Cage. However Applicant's review of Fig. 1, only finds that any disk-shaped flange of elements 12 and 12' is clearly spaced from element 14. Therefore it is Applicant's position that Fig. 1 of Cage does not anticipate the relationship between the disk-shaped flanges and the manifolds and the case of claim 3. Claim 3 therefore further defines over the prior art.

Claim 4 sets forth temperature sensors provided on the pressure resistant case for compensating the thermal effects of a distance between fixed ends on both sides of the flow tubes. Applicant has reviewed the applied references, and finds no teaching nor suggestion of a temperature sensor on a case, and of the temperature sensors provided near joints connecting flow tubes to manifolds. Applicant does find Cage to describe a temperature sensor assembly 72. However this is not applied to the case, is not applied adjacent to joints connecting flow tubes to manifolds. Claim 4 therefore further defines over the prior art.

The rejection recognizes that Cage fails to teach the utilization of a second temperature sensor and holds that this would be obvious since the mere duplication of essential working parts of a device only involves routine skill in the art. However Applicant notes that this is not a mere duplication, since the first temperature sensor is arranged on the pressure case, and the second temperature sensor is arranged on one of the flow tubes and the manifolds. These temperature sensors measure different temperatures, and therefore the use of two temperature

sensors is not mere duplication, but instead the two temperature sensors of claim 4 set forth unique relationships. The prior art does not teach the unique relationships of each of the temperature sensors of claim 4, and therefore claim 4 further defines over the prior art.

Claim 6 sets forth that the axial directions of the first joint ends are non-parallel with the axial directions of the second joint ends. The rejection uses Lew for this feature, and indicates that it would have been obvious to incorporate this feature from Lew into Cage since Cage suggests that a plurality of shapes or flow conduits could be utilized as long as they oscillate in a resonant manner. Applicant notes that the tube arrangement in Cage is such that the perpendicular portions of tubes 11 oscillate toward and away from each other. If these perpendicular portions of Cage were modified so that they did not have axial directions which were parallel to each other, these perpendicular portions would fan out from the manifold in Cage. Such a fanning out of the perpendicular portions, would increase the amount of space required by Cage, and make it difficult to vibrate the tubes. Applicant finds no benefit to such a fanning out. Therefore it is Applicant's position that a person of ordinary skill in the art would not be modified to have any axial directions of joint ends of flow tubes in Cage be non-parallel. Claim 6 therefore further defines over the prior art.

Claim 7 sets forth a slightly similar feature in that the directions of the joint ends are angularly spaced from each other. Again Applicant finds no teaching nor suggestion of how this would be beneficial in Cage. Therefore claim 7 also further defines over Cage.

Claim 8 depends from claim 5 and sets forth a sealed pressure case surrounding the two flow tubes, where the pressure case has a cylindrical shape and where ends of the cylindrical

shape are closed by end plates forming corners with the cylindrical shape. The rejection uses element 14 of Cage to anticipate the case. The rejection states that element 14 of Cage has a cylindrical shape with ends of the cylindrical shape closed by end plates forming corners with the cylindrical shape. Applicant has reviewed Cage, and finds no teaching nor suggestion of element 14 being closed by end plates, with those end plates formed corners with a cylindrical shape. Claim 8 also sets forth that the entry and exit manifolds are arranged in the corners of the case. Since Cage clearly does not teach nor suggest corners, Cage cannot suggest manifolds being arranged in Corners. Claim 8 therefore further defines over the prior art.

Claim 9 sets forth that the ends plates are flanges of the entry and exit manifolds. As Applicant has described previously, Cage does not describe end plates, and therefore cannot describe end plates that are flanges of entry and exit manifolds. Furthermore, Applicant notes that any structure of elements 12 and 12' are not part of element 14. Therefore flanges of 12, and element 14 of Cage do not have the same relationship as the flanges and case of claim 9. Claim 9 therefore further defines over the prior art.

Claim 10 sets forth temperature sensors provided on the pressure resistant case for compensating the thermal effects of a distance between fixed ends on both sides of the flow tubes. Applicant has reviewed the applied references, and finds no teaching nor suggestion of a temperature sensor on a case, and of the temperature sensors provided near joints connecting flow tubes to manifolds. Applicant does find Cage to describe a temperature sensor assembly 72. However this is not applied to the case, is not applied adjacent to joints connecting flow tubes to manifolds. Claim 10 therefore further defines over the prior art.

The rejection recognizes that Cage fails to teach the utilization of a second temperature sensor and holds that this would be obvious since the mere duplication of essential working parts of a device only involves routine skill in the art. However Applicant notes that this is not a mere duplication, since the first temperature sensor is arranged on the pressure case, and the second temperature sensor is arranged on one of the flow tubes and the manifolds. These temperature sensors measure different temperatures, and therefore the use of two temperature sensors is not mere duplication, but instead the two temperature sensors of claim 10 set forth unique relationships to the other structure of the claim. The prior art does not teach the unique relationships of each of the temperature sensors of claim 10, and therefore claim 10 further defines over the prior art.

Claim 11 sets forth that each curve is continuous from the first joint end to the second joint end. The rejection indicates that Cage does not describe each curve being continuous from a first joint end to a second joint end. The rejection then uses the references of Lew or Keita for this feature. As Applicant has described previously, the reference of Cage uses a U-tube, and requires that long straight perpendicular portions to cause the deflection. Applicant notes that if a curved section was substituted in Cage, the long straight sections would not be present and the amount of deflection in Cage would be less. This would make it more difficult to measure the deflection and reduce the accuracy.

The rejection also states that it would have been obvious to use the shapes of Lew or Keita in Cage, since Cage themselves suggests in column 13 lines 30 - 33 that a plurality of shapes of flow conduits could be utilized as long as they oscillate in a resonant manner.

Applicant notes that there is no indication that the shapes of Keita or Lew oscillate in a resonant manner. Therefore the rejection lacks the suggestion or motivation to cause claim 11 to be obvious.

Issue 2

Claim 12 sets forth entry-side and exit-side manifolds. Each of these manifolds have an inlet portion or an outlet portion respectively. Each of these manifolds also has branches that bend at an acute angle to the axial direction of the inlet or outlet portions. The rejection acknowledges that Keita fails to depict the arrangement of these manifolds. The rejection then uses the reference of Lew to teach these manifolds, especially Fig. 5. As Applicant has described previously, Lew provides no distinction between flow tubes and manifolds, especially in Fig. 5. Therefore Lew does not describe the manifolds of claim 12. The combination of the references therefore fails to anticipate all of the features of claim 12, and claim 12 therefore defines over the prior art.

The rejection further states that it would have been obvious to modify Keita in view of Lew, in order to provide multiple conduits that can be resonantly oscillated about an axis that will allow flow measurements to be made in an accurate and efficient manner by also reducing turbulence. Applicant notes that any suggestion or motivation to modify a reference must be found in the prior art, or in the general knowledge of a person of ordinary skill in the art. The rejection does not indicate where this suggestion or motivation can be found in the prior art, or in the general knowledge. Applicant's review of the prior art finds no indication of this

suggestion or motivation being found in the prior art. Therefore claim 12 further defines over the prior art, since the suggestion or motivation to combine the reference is not found in the prior art of the general knowledge.

For all of the above reasons, the Board is respectfully requested to overrule the Examiner and to allow each of the claims in this application.

Respectfully submitted
for Appellant,

By: ______________________

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TD:tf
68596RCE.9

Enclosed: Appendix with Claims
Duplicate copies of Appeal Brief
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McGLEW AND TUTTLE, P.C.

BY: Toni Ann Forte DATE: October 7, 2003

APPENDIX

1. A Coriolis mass flow meter, comprising:

two parallel flow tubes curved into an arch shape having joint ends, each of the joint ends having an end direction;

an entry-side manifold with curved branches connected to one set of said joint ends of said two flow tubes, said branches each carrying a portion of a fluid being measured from an inlet port into said two flow tubes;

an exit-side manifold with curved branches connected to another set of said joint ends of said two flow tubes, said exit-side manifold with curved branches converging flows of said fluid being measured flowing in said two flow tubes into an outlet port to discharge said fluid being measured;

a drive unit for driving and resonating one of said flow tubes with another of said flow tubes at mutually opposite phases; and

a pair of oscillation sensors installed along said two parallel flow tubes curved into an arch shape at locations horizontally symmetrical with respect to an installation location of said drive unit for sensing a phase difference proportional to a Coriolis force, said two flow tubes being connected to said entry-side manifold and to said exit-side manifold at respective said joint ends and said two flow tubes being formed into the arch shape that is bent in only one direction, said entry-side manifold curved branches being smoothly bent from an inlet direction of said entry-side manifold to a connection direction at an end of said two manifold outlets that is the same as the end direction of said joint ends, said exit-side manifold curved branches being

smoothly bent from an outlet direction of said exit-side manifold to a connection direction at an end of said two manifold inlets that is the same as the end direction of said joint ends.

2. A Coriolis mass flow meter as set forth in claim 1 further comprising a sealed pressure-resistant case of a cylindrical shape in axis direction, with openings of the cylindrical portion thereof closed by end plates, wherein said entry-side and exit-side manifolds are installed at corners of said cylindrical portion and passed through said corners.

3. A Coriolis mass flow meter as set forth in claim 1 wherein:

a pressure-resistant case is arranged around said two flow tubes;

said entry-side and exit-side manifolds have a pair of integrally formed disc-shaped flanges, to which both ends of said pressure-resistant case are fixedly fitted;

the cross-sectional shape of said pressure-resistant case being an oval shape with the major axis oriented in the curved direction of said flow tubes, with the length of said major axis smoothly and gradually reduced from the axial central part thereof to both ends thereof into a substantially circular shape over a predetermined length near both ends.

4. A Coriolis mass flow meter as set forth in Claim 3 further comprising a temperature sensor provided on said pressure-resistant case for compensating the thermal effects of a distance between fixed ends on both sides of said flow tubes, and a temperature sensor provided near said joints connecting said flow tubes to said manifolds for compensating the thermal

effects of the rigidity of said flow tubes.

5. A Coriolis mass flow meter comprising:

two flow tubes each having a curve and each flow tube having first and second joint ends, each curve of said flow tubes lying in a respective plane, said planes of said curves of said flow tubes being arranged substantially parallel, said each curve being in only one direction and forming an arch extending fully from a respective said first joint end to a respective second joint end;

an entry-side manifold with an inlet port portion and two outlet ports forming branches curved with respect to the inlet port portion, said two outlet port branches being connected to said first joint ends of said two flow tubes and dividing an entry passage from said inlet port into said branches joined to said two flow tubes, said entry passages having a smooth curve from said inlet port to said outlet ports with an axial direction of each of said outlet ports at an acute angle relative to said an axial direction of said inlet port, an axial direction of said entry passage at said outlet ports being in a substantially same direction as an axial direction of a respective said flow tube at said respective first joint end of said respective flow tube;

an exit-side manifold with an outlet port portion and two inlet port branches, said inlet port branches being connected to said second joint ends of said two flow tubes and joining exit passages from said inlet ports to said outlet port portion, each of said exit passages having a smooth curve from respective said inlet ports to said outlet port with an axial direction of each of said inlet ports at an acute angle relative to an axial direction of said outlet port portion, an

axial direction of said exit passages at said inlet ports being in a substantially same direction as an axial direction of a respective said flow tube at said respective second joint end of said respective flow tube;

a drive unit for driving and resonating one of said flow tubes with respect to another of said flow tubes at mutually opposite phases;

a pair of oscillation sensors installed at locations symmetrical with respect to said drive unit for sensing a phase difference proportional to a Coriolis force of fluid in said two flow tubes.

6. A meter in accordance with claim 5, wherein:

said axial directions of said first joint ends is non-parallel with said axial directions of said second joint ends.

7. A meter in accordance with claim 5, wherein:

said axial directions of said first joint ends is angularly spaced from said axial directions of said second joint ends.

8. A meter in accordance with claim 5, further comprising:

a sealed pressure case surrounding said two flow tubes, said pressure case having a cylindrical shape with ends of said cylindrical shape closed by end plates and forming corners with said cylindrical shape, said entry and exit manifolds being arranged in said corners of said

case.

9. A meter in accordance with claim 8, wherein:

said end plates are flanges of said entry and exit manifolds;

a radial cross section of said pressure case has an oval shape with a major axis of said oval shape being oriented in a curved direction of said flow tubes, a length of said major axis being a maximum at a central portion of said pressure case and diminishing toward said ends of said cylindrical shape to have said cross section of said pressure case change to a substantially circular shape at said ends of said cylindrical shape.

10. A meter in accordance with claim 8, further comprising:

a first temperature sensor arranged on said pressure case and measurable of temperatures effecting a distance between said joint ends of said flow tubes;

a second temperature sensor arranged on one of said flow tubes and said manifolds, said second temperature sensor being measurable of temperatures effecting rigidity of said flow tubes.

11. A meter in accordance with claim 5, wherein:

said each curve is continuous from said first joint end to said second joint end.

12. A Coriolis mass flow meter comprising:

an entry-side manifold with an inlet portion and integral first inlet branch and integral second inlet branch, said inlet portion extending in an axial direction, said first inlet branch bending to terminate at a first inlet branch end with a first inlet connection direction at an acute angle to said axial direction, said second inlet branch bending to terminate at an second inlet branch end with a second inlet connection direction at an acute angle to said axial direction;

an exit-side manifold with an outlet portion and integral first outlet branch and integral second outlet branch, said outlet portion extending substantially in said axial direction, said first inlet branch bending to terminate at a first inlet branch end with a first inlet connection direction at an acute angle to said axial direction, said second inlet branch bending to terminate at an second inlet branch end with a second inlet connection direction at an acute angle to said axial direction;

a first arched flow tube having a curve in only one direction and lying in a first plane, said first arched flow tube extending from a first arched flow tube first joint end to a first arched flow tube second joint end, said first arched flow tube first joint end being along said first inlet connection direction and being connected to said first inlet branch end and said first arched flow tube second joint end being along said first outlet connection direction and being connected to said first outlet branch end;

a second arched flow tube having a curve in only one direction and lying in a second plane, said second arched flow tube extending from a second arched flow tube first joint end to a second arched flow tube second joint end, said second arched flow tube first joint end being along said second inlet connection direction and being connected to said second inlet branch

end and said second arched flow tube second joint end being along said second outlet connection direction and being connected to said second outlet branch end, said first plane and said second plane being substantially parallel;

a drive unit for driving and resonating said first arched flow tube with respect to said second arched flow tube at mutually opposite phases;

a pair of oscillation sensors installed at locations symmetrical with respect to said drive unit for sensing a phase difference proportional to a Coriolis force of fluid in said two flow tubes.